Science Rationale

Students are naturally curious about the world and their place in it. Sustaining this curiosity and giving it a scientific foundation must be a high priority in Arizona schools. Students need to be actively involved in scientific investigations, develop a rational and objective framework for solving problems, and understand the concepts that unify the scientific disciplines. All students must recognize how developments in science impact their personal, societal, and physical environment and how scientific knowledge is developed, organized and interrelated. Scientifically and technologically literate people know how to apply the methods of science and technology for personal and professional growth and are able to use these skills for advancing community well-being.

Science is not a blueprint for rote memorization, and students should not simply be shown results. Science is a process of gathering and evaluating information, looking for patterns, and then devising and testing possible explanations. Knowledge of the history and nature of science and continuous opportunities to conduct scientific inquiries provide a complement to learning the sciences and understanding their relationships to other disciplines.

Students need to recognize the diversity and complexity of the life forms found on Earth in order to understand the network of interrelationships among organisms and between living and non-living things. They must also understand how organisms emerge and adapt in order to survive. Students need to have knowledge of the properties and makeup of matter, the transfer and transformation of different forms of energy, and the results of matter and energy interactions. Students must understand the composition of the Earth, the function of its resources, the impact of weather, and Earth's relationship to other planets in the solar system. Even students who plan no further science study benefit from this information for it makes them better able to appreciate their world and to understand the many scientific and technological issues that face them.

Broad unifying concepts and processes provide a solid base for understanding the specific discipline-oriented concepts presented in several of the standards. The application of these concepts and processes provide students with productive and insightful ways of considering and integrating a range of basic ideas that explain the natural and designed world. Some unifying concepts and processes include:

- systems, order and organization
- evidence, models and explanation
- change, constancy and measurement
- evolution and equilibrium
- form and function

Because the understanding and abilities associated with major conceptual and procedural schemes need to be developed over an entire education, the unifying concepts and processes transcend disciplinary boundaries.

The science standards are set with the expectation that science-related activities occur at all grade levels—from initial explorations in kindergarten through increasingly organized and focused science investigations in higher grades—and that science is taught in conjunction with all subject areas. The methods and thought processes of science have application well beyond the bounds of science and can support the broader goals of all subject areas.

The developers of the Arizona science standards relied heavily on the very thoughtful and carefully crafted content standards found in the *National Science Education Standards*. These standards should serve as the basis for interpreting and teaching the standards outlined in this document.

Table 1. Science Standards

STANDARD 1: **Science as Inquiry**

Students understand and use the processes of scientific investigation and scientific ways of knowing. They are able to design, conduct, describe and evaluate these investigations. They are able to understand and apply concepts that unify scientific disciplines.

STANDARD 2: **History and Nature of Science**

Students understand the nature of scientific ways of thinking. Students understand that scientific investigation grows from the contributions of many people.

STANDARD 3: **Personal and Social Perspectives in Science and Technology**

Students understand the impact of science on human activity and the environment and are proficient in the uses of technology as they relate to science.

STANDARD 4: **Life Science**

Students understand the characteristics of living things, the diversity of life and how organisms change over time in terms of biological adaptation and genetics. Students understand the interrelationships of matter and energy in living organisms and the interactions of living organisms with their environment.

STANDARD 5: **Physical Science**

Students understand the nature of matter and energy including their forms, the changes they undergo and their interactions.

STANDARD 6: **Earth and Space Science**

Students understand the composition, formative processes, and history of the Earth, the solar system and the universe.

SCIENCE STANDARDS
BY LEVEL: READINESS (Kindergarten)

STANDARD 1: SCIENCE AS INQUIRY

Students understand and use the processes of scientific investigation and scientific ways of knowing. They are able to design, conduct, describe and evaluate these investigations. They are able to understand and apply concepts that unify scientific disciplines.

- **1SC-R1. Identify and use safe procedures in all science activities**

  PO 1. Demonstrate safe procedures (e.g., use and care of simple technology, materials and organisms) and behavior in all science inquiry

- **1SC-R2. Ask questions about the natural world (e.g., How do trees grow? Why is the sky blue? Where does rain come from?)**

  PO 1. Formulate questions about objects, organisms, events and relationships in the natural world

- **1SC-R3. Categorize objects, organisms and events in different ways**

  PO 1. Organize (e.g., sort, classify, sequence) objects, organisms and events by different characteristics

- **1SC-R4. State simple hypotheses about cause-and-effect relationships in the environment**

  PO 1. Formulate a question that relates to the environment
  PO 2. Predict the results of an observable cause-and-effect relationship

- **1SC-R5. Perform simple measurements and comparisons**

  PO 1. Perform simple measurements using appropriate devices
  PO 2. Compare objects according to their measurements

- **1SC-R6. Communicate observations and comparisons through various means such as pictographs, pictures, models and words**

  PO 1. Describe observations with pictographs, pictures, models and words
  PO 2. Describe similarities and differences of observations

- **1SC-R7. Observe and describe changes in a simple system (e.g., a plant terrarium)**

  PO 1. Describe changes observed in a simple system (e.g., ant farm, plant terrarium, aquarium)

STANDARD 2: HISTORY AND NATURE OF SCIENCE

Students understand the nature of scientific ways of thinking. Students understand that scientific investigation grows from the contributions of many people.

- **2SC-R1. Understand that all people can and do participate in science**

  PO 1. Give examples of how diverse people (e.g. children, weathermen, cooks, healthcare workers, gardeners) participate in science

STANDARD 3: PERSONAL AND SOCIAL PERSPECTIVES IN SCIENCE AND TECHNOLOGY

Students understand the impact of science on human activity and the environment and are proficient in the uses of technology as they relate to science.

- **3SC-R1. Distinguish between natural and man-made objects**

  PO 1. Identify natural objects
  PO 2. Identify man-made objects
  PO 3. Describe differences between natural and man-made objects

- **3SC-R2. Use simple technology (e.g., scales, balances, magnifiers, computers)**

  PO 1. Demonstrate the proper use of simple technology

STANDARD 4: LIFE SCIENCE

Students understand the characteristics of living things, the diversity of life and how organisms change over time in terms of biological adaptation and genetics. Students understand the interrelationships of matter and energy in living organisms and the interactions of living organisms with their environment.

- **4SC-R1. Distinguish living from non-living things**

  PO 1. Identify living things
  PO 2. Identify non-living things
  PO 3. Describe differences between living and non-living things

- **4SC-R2. Describe the basic needs of living organisms**

  PO 1. Describe the basic needs of living organisms for survival

- **4SC-R3. Recognize and distinguish similarities and differences in diverse species**

  PO 1. Identify observable similarities among diverse species (e.g., number of legs, body coverings, size)
  PO 2. Identify observable differences among diverse species
  PO 3. Compare the observable similarities and differences among diverse species
  PO 4. Explain how plant species adapt to their environment

STANDARD 5: PHYSICAL SCIENCE

Students understand the nature of matter and energy including their forms, the changes they undergo and their interactions.

- **5SC-R1. Compare objects in terms of common physical properties**

  PO 1. Identify physical properties of objects (e.g., shape, texture, size, color)
  PO 2. Compare objects in terms of physical properties

STANDARD 6: EARTH AND SPACE SCIENCE

Students understand the composition, formative processes, and history of the earth, the solar system and the universe.

- **6SC-R1. Identify basic phenomena and changes in the sky (e.g., sunrise, moon, stars)**

  PO 1. Identify basic phenomena in the sky
  PO 2. Describe changes that occur in the sky

- **6SC-R2. Understand that the sun heats and lights the earth**

  PO 1. Demonstrate that the sun heats and lights the earth

- **6SC-R3. Identify how the weather affects daily activities**

  PO 1. Identify basic weather phenomena (e.g., temperature, wind, precipitation)
  PO 2. Explain how weather affects daily activities

- **6SC-R4. Identify basic earth materials (rocks, soils, water and gases) and their common uses**

  PO 1. Identify basic earth materials
  PO 2. Identify common uses of basic earth materials

SCIENCE GLOSSARY

Classify To relate objects and events according to their properties or attributes based on the similarities.

Equilibrium The physical state in which forces and changes occur in opposite and offsetting directions. Steady state, balance, and homeostasis also describe equilibrium states.

Evolution Evolution is a series of changes, some gradual and some sporadic, that accounts for the present form and function of objects, organisms, and natural and designed systems. The general idea of evolution is that the present arises from materials and forms of the past.

Experiment To test a hypothesis through the manipulation and control of independent variables and noting the effects on a dependent variable. Interpreting and presenting results in the form of a report that others can follow to replicate the experiment.

Fact A confirmed, or at least agreed-upon, empirical observation or conclusion.

Homeostasis A relatively stable state of equilibrium or a tendency toward such a state between the different, but interdependent, elements or groups of elements of an organism or group.

Homologous To have the same relative position, value or structure.

Hypothesize To state a tentative generalization of observations or inferences that may be used to explain a relatively large number of events that is subject to immediate or eventual testing by one or more experiments.

Infer To derive a conclusion from facts or premises.

Justify To show or prove that something is right or reasonable.

Measure To express the amount of an object or substance in quantitative terms, such as meters, liters, grams.

Models Tentative schemes or structures that correspond to real objects, events, or classes of events.

Observe To note the properties of objects and situations using the five senses.

Phenomenon An observable fact or event; a fact or event of scientific interest susceptible of scientific description and explanation.

Predict To forecast a future occurrence based on past observation or the extension of an idea.

Protocol The plan of a scientific experiment; a written plan of action.

Scatter Plot A graph of the points representing a collection of data.

Science A set of cognitive and methodological techniques designed to describe and interpret observed or inferred phenomena, past or present, aimed at building a testable body of knowledge which is open to rejection or confirmation.

Scientific Method The use of hypothesis, experiment, inference to derive and improve models.

Science as Inquiry Inquiry is a multifaceted activity which includes asking questions, planning and conducting investigations, using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments.

System An organized group of related objects or components that form a whole. For example, systems can consist of organisms, machines, fundamental particles, galaxies, ideas, numbers, transportation, and education. Systems have boundaries, components, resources flow (input and output), and feedback.

Technology The application of science to solve practical problems, doing something more efficiently, or improving the quality of life.

Theory An integrated, comprehensive explanation of a lot of facts and capable of generating hypotheses and testable predictions about the natural world.

Venn diagram An arrangement of circles to represent logical relationships demonstrated by the inclusion, exclusion or the intersection of circles.